MAY/JUNE 2007

Zoogoer

VOLUME 36, NUMBER 3

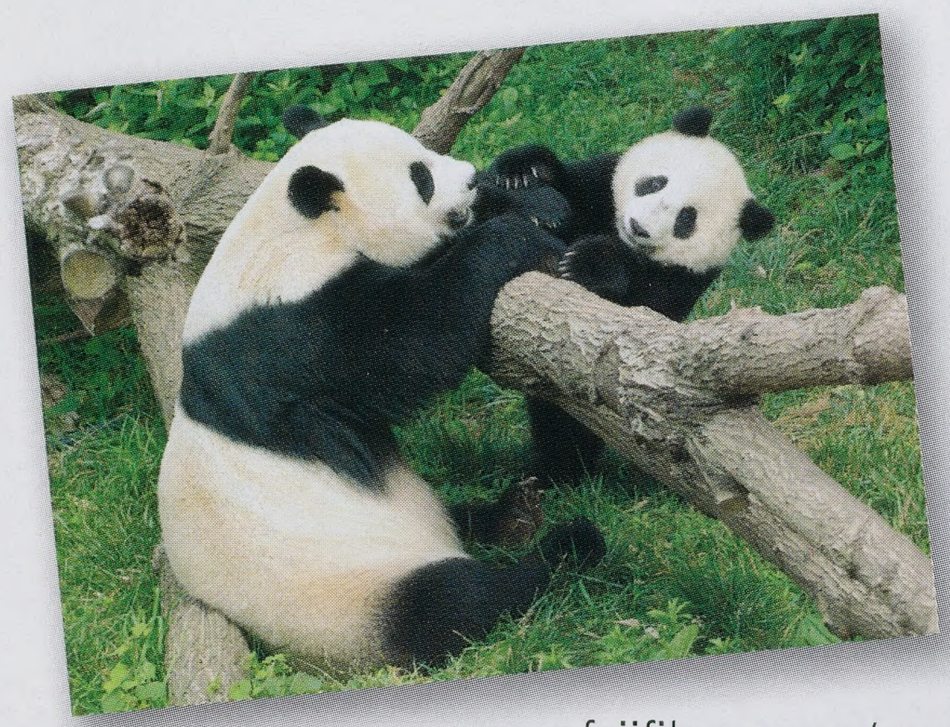
FUJIFILM

FONZ
Friends of the National Zoo

Smithsonian
National
Zoological
Park

Fujifilm, the Smithsonian's National Zoo and Friends of the National Zoo are working together to help protect giant pandas and secure their future through education and research.

Visit and enjoy giant pandas Mei Xiang, Tian Tian and Tai Shan at the Fujifilm Giant Panda Habitat as well as six other Asian species along the Asia Trail.



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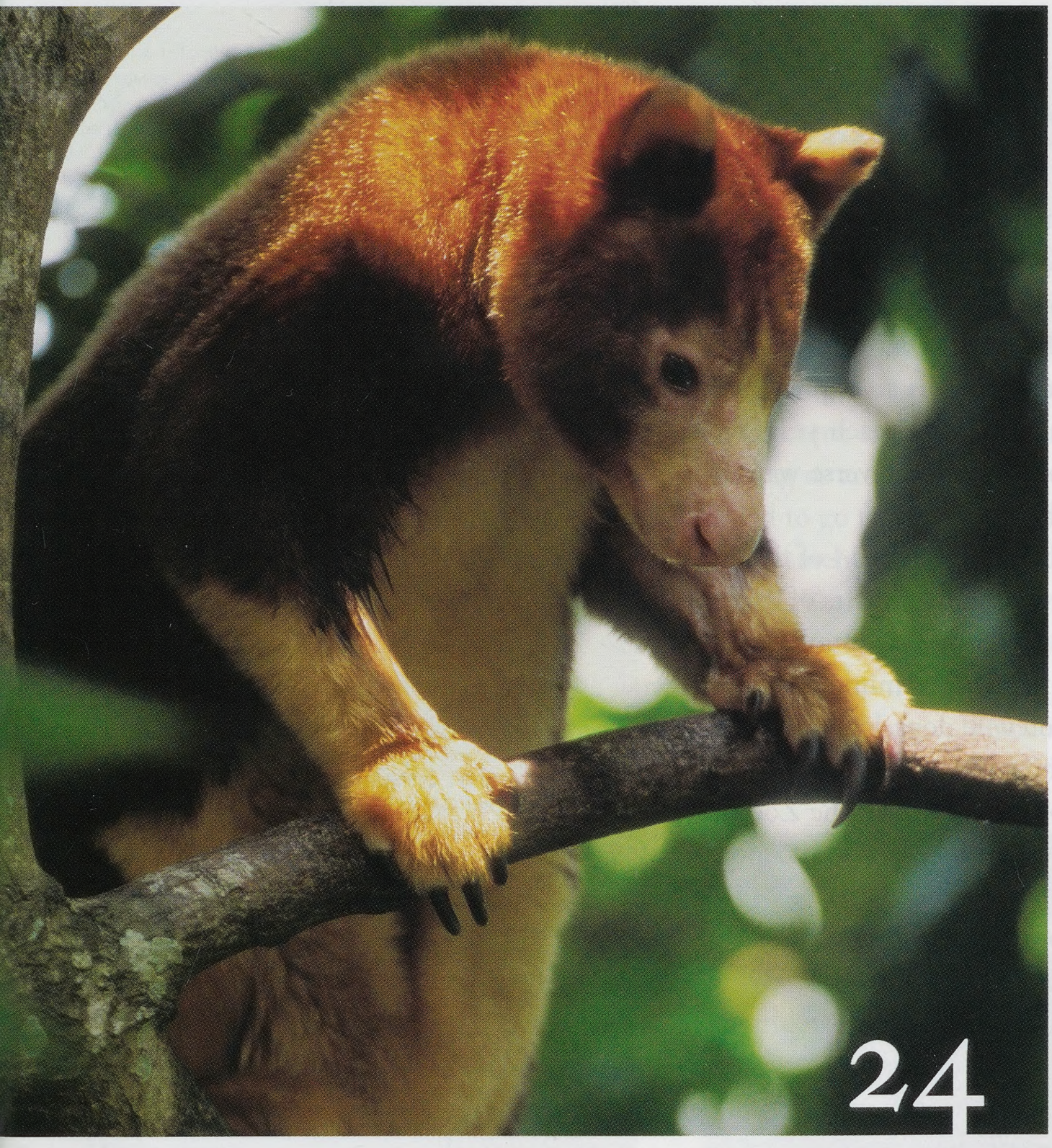

Matschie's tree kangaroo: Pete Oxford/naturepl.com. Pigeons: Georgette Douwma/naturepl.com

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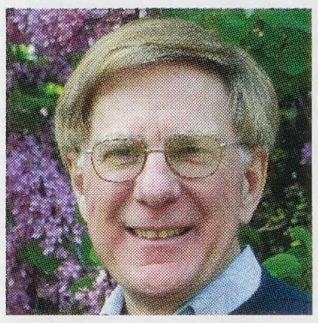
Savanna Soirée & Supporting Science



In a few weeks, on May 17, FONZ will host its 24th National ZooFari, our annual gala fundraiser for the Smithsonian's National Zoo. This is a fabulous event—an evening of fine food and fun coupled with a serious purpose. ZooFari raises funds essential to Zoo exhibition and conservation science programs. It also gives us an opportunity to highlight some of these programs in a special way each year. We've dubbed this year's ZooFari "Savanna Soirée" to focus attention on the diverse ways Zoo staff contribute to the conservation of African species and habitats.

As you will read in "The Zoo's African Odyssey," which begins on page 14 of this issue of *ZooGoer*, Zoo staff are working to study and help protect species in all parts of that vast continent, from the dry Sahara-Sahel in the north to the rainforests of Central Africa to the eastern and southern savannas. Their efforts include professional training; biodiversity monitoring; and field and lab studies of African elephants and wild dogs. Here at the Zoo, we exhibit many African species that are part of Species Survival Plan breeding programs, such as Grevy's zebras, western lowland gorillas, and the lions that came to the Zoo from Africa last October. In many cases, the species our scientists work with in the wild are also studied at the Zoo, such as kori bustards and meerkats.

Critical support for many of these programs comes from FONZ members, through your dues, donations, purchases at the Zoo, and participation in ZooFari and other fundraising events. Your generous response to our recent appeal for funds to help reintroduce scimitar-horned oryx to the Sahara provided a significant boost to this important program. Your contributions paid for the African lions' transport to the Zoo, support studies of the reproduction and genetics of African elephants, and much more.

For many years, you have supported the Zoo's wide-ranging cheetah conservation program that led to such breakthroughs as the first birth of cubs following artificial insemination, and now includes genome resource banking as well as projects to reduce conflict between cheetahs and ranchers in Namibia.

Now, I am pleased to announce that one generous donor—a long-time FONZ member and ZooFari patron—recently committed $1 million to build a new cheetah breeding and research facility at our Conservation and Research Center in Front Royal, Virginia! Work at this facility will complement and expand the breeding program at the Zoo in Rock Creek and let our scientists conduct even more in-depth research on this species.

As important as direct financial support is, I must give a nod to our volunteers. FONZ volunteers teach visitors about the Zoo's African animals and efforts to conserve them. They conduct behavioral observations on Zoo animals for scientific research. And they make fundraising events like ZooFari possible and profitable. Nearly everyone who works at ZooFari, from the people who take tickets to those serving drinks and staffing the silent auction, is a volunteer donating his or her time to the Zoo cause.

Thank you for supporting our work to save species and their habitats. I look forward to meeting you at ZooFari and, with you, enjoying our great party for a great cause.

Sincerely,

Bob Lamb

Bob Lamb
Executive Director, Friends of the National Zoo

FONZ Friends of the National Zoo is a nonprofit organization dedicated to supporting the conservation, education, and research efforts of the Smithsonian's National Zoo. Formed in 1958, FONZ was one of the first conservation organizations in the nation's capital. Friends of the National Zoo is dedicated to supporting the National Zoo in a joint mission to study, celebrate, and protect the diversity of animals and their habitats.

ZooGoer [ISSN 0163-416X] is published bimonthly by Friends of the National Zoo (offices located at the Smithsonian's National Zoological Park, 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537) to promote its aims and programs, and to provide information about FONZ activities to its members, volunteers, and others interested in the purposes of FONZ. Periodicals postage paid at Washington, D.C. Postmaster: Send change of address to *ZooGoer*, 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537. Copyright ©2007. All rights reserved.

Smithsonian **National Zoological Park** is located at 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537. Weather permitting, the Zoo is open every day except December 25. Hours: From March 15 to October 31, 2007, grounds are open from 6 a.m. to 8 p.m.; buildings, 10 a.m. to 6 p.m., with the last admission to buildings at 5:45 p.m. From November 1, 2007 to March 31, 2008, grounds are open from 6 a.m. to 6 p.m.; buildings, 10 a.m. to 4:30 p.m.

Membership in FONZ offers many benefits: programs, publications, discounts on shopping and events, free parking, and invitations to special programs and activities to make zoogoing more enjoyable and educational. To join, write FONZ Membership, National Zoological Park, 3001 Connecticut Ave., N.W., Washington, D.C., 20008-2537, call 202.633.3034, or go to www.fonz.org/join.htm.

Membership categories and annual tax-deductible dues are:

Household	$55
Young Professional	$40
Individual	$40
Senior	$35
Contributing	$100
Sustaining	$150
Patron	$250
Sponsor	$500
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($8 of membership dues goes to a *ZooGoer* subscription)

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An audio version of *ZooGoer* is available on our website, for members who cannot read standard print due to disability. For more information, please visit **www.fonz.org/zoogoer.htm.**

On the cover: Black-and-rufous giant elephant-shrews are one of many African species on exhibit at the Smithsonian's National Zoo. Photo by Jessie Cohen/NZP.

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The Smithsonian's National Zoo is accredited by the Association of Zoos and Aquariums.

Giant News About Giant Pandas

By the time you read this, I suspect you will have heard this fantastic news: Tai Shan is staying at the Smithsonian's National Zoo!

As this issue of *ZooGoer* goes to press, we are preparing to announce that our beloved giant panda cub, Tai Shan, will make his home at the Zoo until he is at least four years old, instead of leaving us around his second birthday, when he was originally scheduled to go to his native China as specified in our giant panda loan agreement with the China Wildlife Conservation Association (CWCA). In our discussions during my December 2006 visit to China, however, we agreed that amending those terms was a win-win-win situation.

The National Zoo and its legions of Tai Shan fans win because we can continue to watch and delight in Tai as he becomes an adolescent and then an adult. What's more, our scientists will be able to continue their studies of his growth and development to document changes during this little-known stage of a panda's life. They will also be able to study behavioral interactions between the maturing Tai Shan and adult male Tian Tian, another aspect of giant pandas we know very little about.

Jessie Cohen/NZP

Tai Shan will stay at the Zoo until he's at least four.

CWCA wins. Its leaders are thrilled with Tai's celebrity as an ambassador for the U.S.-China cooperative giant panda conservation program and for the species. Tai Shan has helped awaken an appreciation for what it takes to conserve an endangered species; millions of people visit him at the Zoo, follow his life on our website, and read about him in countless media stories.

Giant pandas win too because, thanks in part to that partnership, the species is facing a brighter future than it was just a few years ago.* And because Tai Shan will not be sexually mature until about the time he goes to China, his staying with us will not compromise the Chinese breeding program.

Our colleagues at CWCA are also impressed with our state-of-the-art Fujifilm Giant Panda Habitat, with its spacious, enriching yards and enclosures and plenty of room for up to eight pandas. And, of course, all recognize the experience and expertise of the animal care and science staff who work with giant pandas here and abroad. What a great place for a panda to grow up!

And that brings me to my second subject: Mei Xiang's artificial insemination and our hopes for the arrival of another panda baby this summer. We weren't sure whether Mei Xiang would become reproductively active this spring. We have almost no scientific data on how long nursing, especially nursing as long as Mei did, suppresses female reproduction. But our scientists continued to monitor the pandas' hormonal, behavioral, and other changes, and in early April, Tian Tian's behavior provided the first clue that Mei Xiang was about to go into estrus. Mei Xiang's hormonal profile confirmed this and on April 4, it showed that she had ovulated. And at that moment our scientists sprang into action to perform two artificial inseminations about 12 hours apart.

This time, though, the semen came not from Tian Tian but from the San Diego Zoo's male Gao Gao. Why such a bicoastal affair? National Zoo scientist Jonathan Ballou determined that Mei Xiang and Gao Gao make, genetically speaking, a great pair. While Tian Tian's genes are well represented in the zoo population, Mei's and Gao's are not, so any offspring of this pairing would be particularly valuable to the population's future genetic diversity.

Soon after this plan was approved by CWCA and the U.S. Fish and Wildlife Service, Zoo reproduction specialists JoGayle Howard and Copper Aitken-Palmer traveled to the San Diego Zoo. With generous assistance from our colleagues there, they collected and froze semen from Gao Gao, using new techniques developed at the Zoo that improve sperm survival after thawing. When examined before the inseminations, the quality of the thawed sperm looked great and the two subsequent insemination procedures, performed by JoGayle, went without a hitch.

Now all we can do is wait, with all the patience we can muster, to see whether Mei Xiang gives birth. No reliable pregnancy test has yet been developed—although our scientists are working on it—and even the interval between conception and birth is unpredictable. You will be able to learn what we know, when we know it, via our website's Panda Pregnancy Watch, so log on often to **www.fonz.org/pandapregnancy.htm**. And, keep your fingers crossed—every giant panda birth contributes to our efforts to save this endangered species.

Sincerely,

John Berry

John Berry
Director, Smithsonian's National Zoological Park

See my March/April 2007* ZooGoer *letter online at* ***www.fonz.org/berryletter.htm*.

Mehgan Murphy/NZP

Giant panda Mei Xiang was artificially inseminated in April. She may give birth to her second cub as early as August.

Animal News

Tai Shan, the first **giant panda** (*Ailuropoda melanoleuca*) born at the Fujifilm Giant Panda Habitat, may be sharing the spotlight with a new black-and-white baby later this summer. That's when his mother, Mei Xiang, could give birth to her second cub.

Smithsonian's National Zoo scientists and veterinarians artificially inseminated Mei Xiang on April 4 and 5 with semen from a male at the San Diego Zoo named Gao Gao. Zoo reproduction scientists chose Gao Gao because his genes are less represented in zoo populations than those of Tian Tian, the Zoo's adult male giant panda. Zoo staff and FONZ volunteers are keeping a close watch on Mei Xiang's behavior and hormones, but no one will know whether she is pregnant until July at the earliest.

One thing is certain: Tai Shan will remain here past his second birthday. Chinese Ambassador Zhou Wenzhong and Zoo Director John Berry plan to announce on April 24 that Tai Shan will not go to China this summer as originally planned, but will stay at the Zoo until he is at least four years old. For more giant panda updates, visit **www.fonz.org/giantpandas.htm**.

Like Tai Shan, five-year-old **Asian elephant** (*Elephas maximus*) male Kandula was conceived by artificial insemination. And also like Tai Shan, Kandula may have a sibling relatively soon. Zoo experts and veterinary scientists from the Zoo and the Institute for Zoo and Wildlife Research in Berlin, Germany, performed a series of three artificial insemination procedures on Kandula's mother, Shanthi, between March 31 and April 2. Semen from bull elephants at the Tulsa Zoo in Oklahoma and the Fort Worth Zoo in Texas was used in the procedures. The Zoo's Asian elephant and giant panda breeding programs are managed under the auspices of the Association of Zoos and Aquariums' (AZA) Species Survival Plan (SSP) for the species.

Asian elephants' gestation periods are much longer than giant pandas'—about 21 months—but hormonal analyses will indicate if Shanthi is pregnant by July. If she gives birth, her calf will be a member of a matriarchal herd at the Zoo's Elephant Trails exhibit, on which construction will begin this summer. For more Asian elephant updates, visit **www.fonz.org/elephants.htm**.

Two **black-and-rufous giant elephant-shrews** (*Rhynchocyon petersi*) that emerged from their nest at the Small Mammal House on March 5 are the first of their species ever born at the Zoo. Native to eastern Africa, black-and-rufous giant elephant-shrews have a deceptive name—they are neither shrews nor elephants.

On March 15, five female **Przewalski's horses** (*Equus caballus przewalskii*) from European zoos arrived at the Zoo's Conservation and Research Center (CRC) in Front Royal, Virginia. They were brought to the U.S. on the recommendation of the AZA SSP to increase the genetic diversity of the species in North American zoos. Native to Mongolia and China, Przewalski's horses went extinct in the wild in the 1970s. The CRC will keep Maja, a mare from Wilhelma Zoo in Stuttgart, Germany, and Emma, a mare from Planckendael Zoo in Antwerp, Belgium, to contribute to the Zoo's longstanding breeding, reintroduction, and conservation efforts. The rest of the mares will go to other U.S. zoos in May.

Events

For more information on upcoming events at the Zoo, visit **www.fonz.org/events.htm**.

Guppy Gala

May 11—6 to 8:30 p.m.

Kids deserve a wild party of their own, so every year FONZ hosts Guppy Gala for children ages two to 12 and their families. It's a ton of fun, with a rock-climbing wall, moonbounces, arts and crafts, live entertainment, and delicious treats. Proceeds support the National Zoo's public education programs. Tickets sold online only at **www.fonz.org/guppy.htm**.

National ZooFari: Savanna Soirée

May 17—6:30 to 10 p.m.

Food and wine lovers, take note: FONZ's annual epicurean extravaganza features more than 100 of the Washington, D.C., area's finest restaurants, and vintners from around the country, plus fabulous live entertainment. This year's theme, "Savanna Soirée," celebrates the Zoo's African species and Zoo scientists' work with African wildlife. Don't miss the silent auction, where you can bid on fantastic treasures including art, weekend getaways, wine, sporting event tickets, and much more. Proceeds fund a variety of Zoo initiatives. Tickets sold online only at **www.fonz.org/zoofari.htm**.

Cockadoodle Zoo

June 16—7:30 to 10 a.m.

One morning each year, we open the Zoo exclusively to FONZ members to thank you for your generous support. Check out how the Zoo and its animals start their day at this free event. While you're here, visit our one-year-old Sumatran tiger cubs. Please bring your membership card or the June/July issue of *Wildlife Adventures* for admittance.

Jessie Cohen/NZP

Sunset Serenades

Thursdays from June 28 to August 2—6:30 to 8 p.m.

Enjoy the great outdoors and great music with your family at the Zoo's evening summer concerts on Lion/Tiger Hill. Groove to the sounds of jazz, folk, blues, and rock-and-roll. Free and open to the public. Visit **www.fonz.org/sunsetserenades.htm** for a concert schedule.

Call to Nominations

In accordance with our Bylaws, the Friends of the National Zoo Board of Directors is now soliciting nominations from the membership. Our volunteer Board plays an essential role in FONZ leadership, and we rely on our members to recommend people with appropriate skills and talents to guide our efforts to connect people with wildlife and to support the work of our partner, the Smithsonian's National Zoological Park.

I ask you to help by nominating to the Board persons who are interested in this very special community service. Nominations will be reviewed by the Board's Nominating Committee. The names of selected candidates will be forwarded to the membership for election. The criteria by which potential candidates are judged for nomination to the Board of Directors include: the candidate's strong interest in supporting zoological education, research, and conservation in accordance with the purposes of our corporation; leadership; experience or skills that are needed and that would directly benefit FONZ management and operations; and the willingness to commit significant amounts of time to participate fully in FONZ work and activities. Candidates must be dues-paying members of FONZ.

Much of the Board's work is accomplished through several standing committees, such as the Development Committee and the Finance and Audit Committee, and through task forces and other committees. All Board members are expected to serve on committees and may be asked to attend one meeting or function each month.

Nominations may be made only by dues-paying members and must be submitted on an official FONZ Nomination Form with a biography of the nominee. Call 202.633.4379 to receive nomination forms or to discuss Board services with me or a member of the Board. The deadline for submitting nominations is June 4, 2007.

Bob Lamb

Bob Lamb
Executive Director, FONZ

Lectures

Lectures are free and open to the public. For more information and to RSVP, visit **www.fonz.org/lectures.htm.**

Songbird Journeys

May 3—Book signing 7 p.m., lecture at 7:30

As part of the Zoo's celebration of International Migratory Bird Day, Miyoko Chu, an ornithologist and staff writer at the Cornell Lab of Ornithology, signs copies of her book and talks about the scientific quest to answer age-old questions about songbirds.

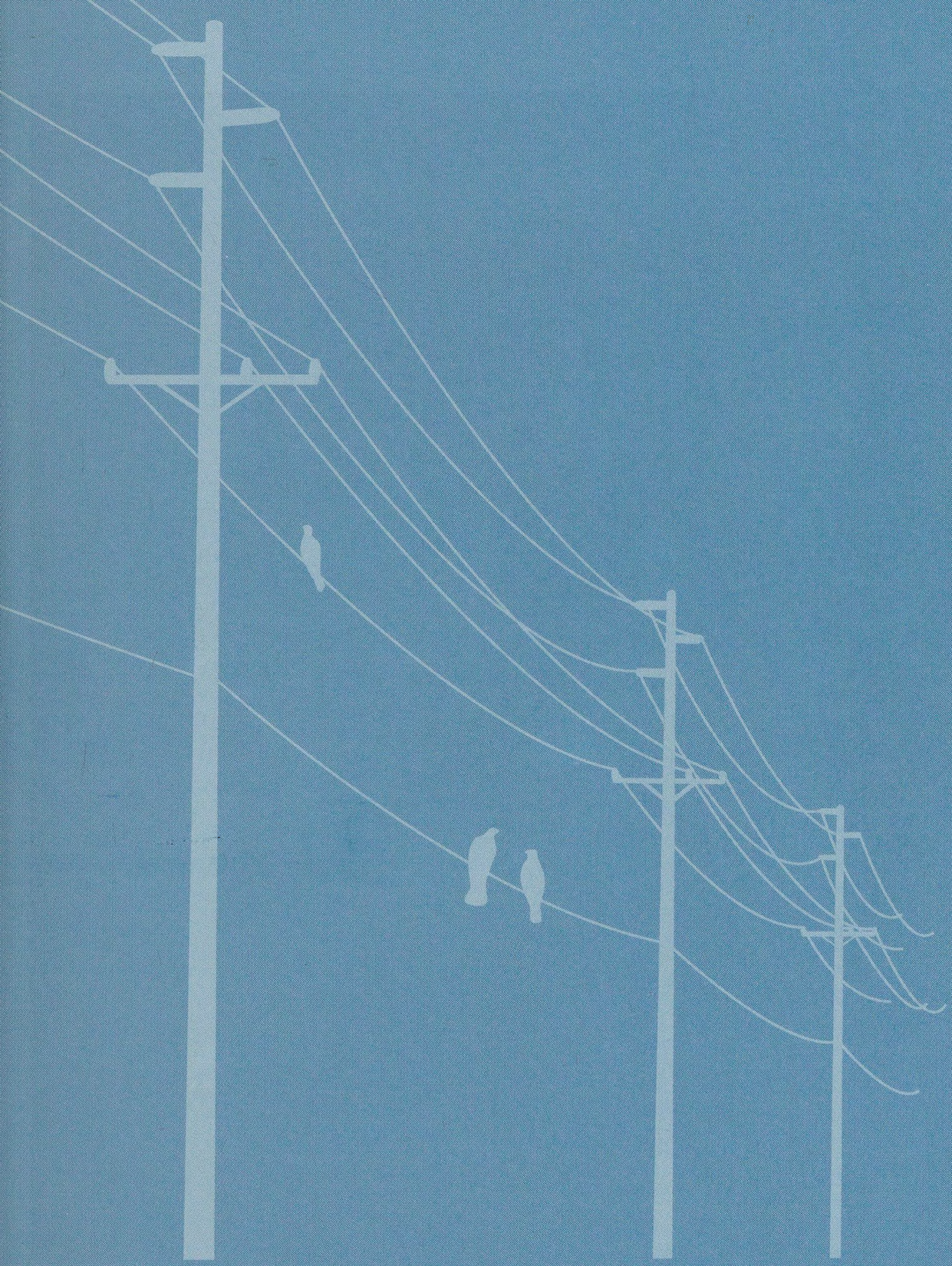
Bonobo Behavior and Conservation

June 19—Wine reception 6 p.m., lecture at 7*

Primatologist Jef Dupain, Congo Heartland Coordinator for the African Wildlife Foundation, will talk about the unique behaviors of critically endangered bonobos—one of humankind's closest living relatives—and efforts to create a nationally recognized and protected reserve in the Democratic Republic of Congo to ensure their future. Wine will be supplied courtesy of Papio Wines, which contributes a portion of its profits to the protection of primates and their habitats. **This lecture was originally scheduled for May 31.*

Pigeons are ubiquitous in Baltimore and cities around the globe. Studies show that worldwide, urban areas are inhabited by similar species and have similar ecologies.

Georgette Douwma/naturepl.com



A City's Living Secrets

BY CHRISTOPHER MIMS

As of this year, more than half of the Earth's six billion people live in cities. In the United States, which in this respect is typical of the developed world, 80 percent of the population lives in urban areas, and metropolitan areas collectively occupy 20 percent of the country's land area.

Despite our overwhelming numbers, the proportion of the Earth's surface that humankind has covered with built structures is miniscule, only 0.2 percent of the planet's total land area. Yet the impact of cities on the environment is disproportionately large. One way scientists describe cities is to compare them to coral reefs. Both support high amounts of diversity and cycle through large amounts of material, and both depend on huge inputs of energy and matter from outside their boundaries, such as the open ocean or grain belts and manufacturing centers.

Cities would be worth studying for their impacts on the global environment, but there is more to them than that. As the backdrop of nearly all Americans' waking hours, cities are the only nature readily available to most of us. Yet the usual feeling, even among some ecologists, is that given the pollution, crowding, and ecological disturbance in most urban areas, cities must be environmentally broken, hostile to life, and devoid of biodiversity. That this is not so is perhaps the most incredible finding of a Long Term Ecological Research (LTER) study in Baltimore: In some ways, the creatures in cities are thriving. It's just that until now, we hadn't known what to look for.

Baltimore's Inner Harbor fronts the Chesapeake Bay. Water quality in the bay is negatively affected by paved surfaces, and by fertilizer and pesticide runoff from nearby farms and suburban lawns.

Science and the City

"Do you ever watch the TV show *The Wire*?" asks social scientist Morgan Grove, referring to the bleak HBO series that depicts the struggles between police and drug-dealing gangs in Baltimore. "That's our neighborhood."

Hard as it is to believe, Baltimore's infamous west side, which is known to the scientists who study it as watershed 263, is an important part of an effort to foment a revolution in the study of living systems.

"This is one of the most exciting things in environmental science in the last 20 years or so," says Peter Groffman, a soil scientist and Grove's colleague. Both work on the Baltimore Ecosystem Study (BES), which, along with a parallel study of Phoenix, Arizona, is the first large-scale, long-term study of an urban ecosystem ever conducted in the United States.

The BES began in 1997 with a grant from the National Science Foundation. It is one of 26 LTER studies, located in such varied ecosystems as the coast of Santa Barbara and the Arctic, that measure how ecosystems change over time. By studying sites that fall along a gradient from relatively pristine to completely urbanized, scientists can understand how urban environments differ from their less-developed counterparts.

The BES takes place in Baltimore, its surrounding suburbs, and nearby agricultural areas. Like the ecosystem it covers, it is complex and multifaceted, and is unusual in that it employs nearly as many social scientists as ecologists. Both groups collaborate on interdisciplinary research that incorporates traditional sciences such as geography, meteorology, demographics, and modeling, and, because so much depends on humans in urban areas, social sciences, public health, and education.

Twenty years ago it would have been heresy for a team of ecologists to be given tens of millions of dollars in federal grant money to study Baltimore, which was settled by Europeans nearly 300 years ago, and Native Americans centuries before then. Except for Phoenix, all of the other LTER sites are located in habitats where humans rarely venture—the sorts of places in which young graduate students imagine themselves living in a tent and waking to the sounds of songbirds. Or most young graduate students, at any rate.

"I've always worked in urban areas," confesses Charles Nilon, a professor at University of Missouri-Columbia who has studied urban birds for the past ten years as part of the BES. Nilon's unusual pedigree is typically atypical for members of the BES, many of whom enjoy studying environments their colleagues went into ecology to avoid.

Nilon and his fellow BES scientists try to synthesize their research, whether they are ecologists or the many social scientists whose work is integral to the project. However, on their own, they,

like the majority of the world's scientists, are subspecialists whose work is a narrowly focused attempt to understand phenomena. In the BES, those phenomena are the features of a city that determine the nature of its most visible nonhuman inhabitants.

Cities of a Feather

Nilon studies some of the most forgettable species on Earth. They are ubiquitous, and therefore easy to take for granted. You probably saw at least one of them today, squabbling over crumbs or perched on a power line. If you live in a densely urban area, it was likely a pigeon, chimney swift, or house sparrow. If you live in a more suburban area, it might have been a starling, grackle, mockingbird, crow, mourning dove, or robin.

These nine types of birds showed up at more than half of the randomly selected sampling points in Nilon's study of the distribution of birds in Baltimore City. Like many city-dwelling organisms, these birds are truly synanthropic—their relationship with humans surpasses mere cohabitation.

Some synanthropic species have been with humans so long that no one knows exactly where they originated. House sparrows, for example, came from somewhere in Europe or Asia, but exactly where is unknown. And while rock doves—otherwise known as pigeons—still live in some nonurban areas, without humans they would not be such a runaway evolutionary success.

Of the nine types of birds that recurred in his Baltimore study, "you can substitute one or two of those and you'd see those same species in just about any city in the U.S.," says Nilon. "If you go to European cities you might find a slightly different [set] of birds, but it would be a similar group with similar requirements. For example, there are also jay species and crow species that can be found across the world in urban areas—they're slightly different, but they have similar niches."

In a way, it makes sense. Cities everywhere are similar—parks, streets, houses, trash. Nearly all cities are mosaics of built and unbuilt land, natural and artificial surfaces, disturbed and relatively undisturbed areas. Like the Amazon versus the African rainforest, or the Siberian versus the Canadian arctic, all cities are the same, but different.

House sparrow.

Jean Claude Carton/Bruce Coleman Inc.

Cities are, in general, warmer than the surrounding countryside. Scientists at the Phoenix LTER study suggest that cities do not experience hot and cold, or rainy and dry seasons like most ecosystems; that, regardless of their latitude, "cities can be viewed as 'pseudo-tropical bubbles.'"

Due to the patchiness of cities and to people's aversion to having bears, coyotes, and moose around their offspring and pets, urban areas typically lack large predators and herbivores. There are exceptions: Washington, D.C., for example, is inhabited by white-tailed deer and coyotes, because Rock Creek Park runs through the center of town. But in general, without predators and with year-round supplies of water and food, urban squirrels, raccoons, and other animals' biggest challenge is a constantly changing environment that demands flexibility.

From Earthworms to the Ocean

"On campus, near where I am, there are spots where the earth is moving—it's just unbelievable," says Katalin Szlavecz, an ecologist at Johns Hopkins University and one of a handful of BES soil scientists. The roiling earth she describes isn't a geological effect—it's due to the presence of huge numbers of drought-tolerant, six-inch-long earthworms (*Amynthas corticis*). Invaders from Asia, the worms' explosive seasonal breeding and enormous size are in some respects overwhelming Baltimore's ecosystem.

"They're called 'snake-worms,'" continues Szlavecz, whose tone suggests the most rambunctious creatures she usually deals with are small, shy, and slow-moving. "They're large, they jump, and they are very fast. They are tropical worms and in summertime can reach really huge densities."

Like Japanese kudzu, *A. corticis* are typical of the exotic species that have invaded the U.S. South: They thrive in the heat-bubble effect of Baltimore and other cities in northern latitudes where they might otherwise fare worse.

No earthworm species, including large, jumping earthworms, are native to the northern reaches of the United States, although some may be native to Baltimore. According to Szlavecz, earthworms did not exist in areas covered by glaciers during the last ice age, which at one point extended as far south as New Jersey. They arrived in the ship ballasts of the first European settlers, which was shoveled directly onto American shores. *A. corticis* is a more recent arrival, and its exact means of entering the U.S. is not known.

Mourning doves.

Larry Ditto/Bruce Coleman Inc.

Katalin Szlavecz

A specimen of *Amynthas hilgendorfi* earthworm, a more common relative of the earthworm *A. corticis*, found during the BES.

Earthworms are good for gardens because they eat detritus such as leaves, mulch, and dead plant matter on the ground. Their feces provide a friendly environment for microbes that convert, or fix, nitrogen—a relatively inert gas we breathe every day that constitutes 78 percent of Earth's atmosphere—into ammonium and nitrate. Unlike nitrogen gas, these two fixed chemicals are usable by plants for growth.

In areas with adequate rainfall, the availability of fixed nitrogen determines the productivity of plants. For instance, without the miracle of artificial nitrate fertilizers, agricultural productivity would be a fraction of its current level, and it would be nearly impossible to feed the Earth's population. On the other hand, massive amounts of nitrate, mostly in leftover fertilizer, wash into the sea and cause huge blooms of algae that choke oceans worldwide and make the Chesapeake Bay an "impaired waterway."

The problem with *A. corticis* is that it is so good at turning leaf litter into feces on which nitrate-producing microbes thrive that it is causing nitrate to be produced faster than ecosystems can use it. Much of the surplus is washed away with the rain, at once stealing precious nutrients from forests and dumping them into nearby streams.

The Ecology of Prestige

"You talk to your ecologist friends and they talk about how they stopped cutting their grass because they want it to go back to 'nature,' and their neighbors hate them—it's like they thrive on becoming outcasts," says BES social scientist Morgan Grove. "So I thought to myself, I'm going to do the opposite—I'm going to nuke my lawn. I'm going to have the greenest lawn possible and see how it enhances my social acceptability."

Grove wasn't merely engaging in an act of crass social climbing when he decided to turn his lawn into a novel shade of day-glo green through assiduous watering and fertilizing. Rather, he was conducting an experiment based on insights gained from his research. By his own account, the experiment was a smashing success. "I'd be at dinner parties and people would say, 'Where do you live?'" explains Grove. "I'd say 'Oh, I live at the corner of such and such,' and they would say 'Oh! You're the one with the lawn!'" Their admiration was just one piece of anecdotal evidence that corroborated Grove's previous research, which indicates that a neatly manicured lawn is a powerful force for social status and neighborhood cohesion.

Lawns are the second-most extensively irrigated crop in the United States, trailing only corn and well ahead of wheat and soybeans. And lawns are paradoxes. Although they are energy-intensive and increase pesticide and herbicide runoff into waterways, their bum rap may be somewhat undeserved.

According to results from the BES, lawns may absorb carbon from the atmosphere and sock it away in the soil—a neat trick in this age of concern about rising carbon levels in the atmosphere. But that doesn't take into account the mowing and fertilizing lawns require.

"Using satellite imagery, we can measure the productivity of lawns," says Grove. "So we said, 'all right, is this a reflection of population density, socioeconomic status, or lifestyle choices?' It turns out that lifestyle choices are the best predictor of lawn productivity. ...When you rely only on ecological variables to explain the variation you see, [you don't get a very good correlation]. But when you include social data, [the correlation] goes way up."

These social factors are part of what Grove calls an "ecology of prestige." He believes they will be essential in understanding how to make cities, where natural and artificial ecosystems intersect, work better. By revealing the forces that shape a city's ecosystem, this approach tells us something about how to wield them. "From a management perspective," explains Grove, "If you want to increase the amount of vegetation in an area, or conserve vegetation...you'd want to appeal to social status."

The Importance of History

By recognizing that humans are a primary driver of the urban ecosystem, the BES is expanding the scope of ecology well beyond what it has ever previously encompassed. It is also opening a Pandora's box of new questions that demand new kinds of data—economic, sociological, and historical.

Why, for example, is a given neighborhood inhabited by people who can afford to lavish attention on their lawns? To answer this question and others like it, scientists from diverse disciplines have traced the roots of Baltimore to its earliest days of European settlement.

In the late 19th century, waterborne diseases killed one in four infants in Baltimore's low-lying areas, so higher parts of the city were considered more desirable for human habitation. In 1931, "a zoning ordinance drew a line and said industrial activity could only happen in [low-lying areas]," says Chris Boone, who specializes in environmental justice.

If Baltimore had been like other cities Boone has studied, including Los Angeles and Phoenix, the low-lying industrial areas would subsequently have been inhabited by groups socially and economically disadvantaged by their race—in the case of Baltimore,

African Americans. But a funny thing happened in Baltimore: Whites who preferentially held jobs at Bethlehem Steel and other waterfront plants ended up living close by so they could walk to work. Later, this preference was reinforced by legal residential segregation and zoning laws that grouped Baltimore's citizens by race.

As a result, Baltimore is the inverse of most cities, where toxic waste dumps and other environmental hazards tend to end up in communities of color; in Baltimore, whites are more likely than African Americans to live next to Toxic Release Inventory sites. "[The 1931 zoning ordinance] put an institutional stamp on where those future Toxic Release Inventory sites would be," says Boone.

This finding, which is impossible to generalize to other cities, has profound implications. It illustrates how cities evolve: Just as historical contingency is the only logical explanation for humans' vestigial organs, which are really just modified versions of old adaptations, history has a powerful effect on the current shape of an urban ecosystem's built areas. In turn, people who live in cities make decisions that shape the lives of the area's flora and fauna.

Although historical contingency makes it difficult to generalize some observations about cities, the class and lifestyle differences it creates often have consistent results. For example, even though higher-income residents in Phoenix do not live in old industrial sections of town as they do in some parts of Baltimore, their socioeconomic status has an effect on their surrounding ecosystem.

"[In Phoenix] one of the things I found was that higher-income neighborhoods had high plant-species diversity, while low-income neighborhoods had low species diversity," says Paige Warren, a research associate professor at the University of Massachusetts Amherst and one of the few scientists to conduct studies in both the Baltimore and Phoenix LTER sites. Warren hypothesizes that this difference in plant diversity drove the variability in bird species she discovered.

So it's not just humans that find higher-income neighborhoods more desirable—birds have the same preference. The effect is more pronounced in Phoenix than in Baltimore, where areas that include row houses with lots of long-standing vegetation exist in both rich and poor areas. Regardless, Warren's finding is an example of how social and economic factors have direct and not always intuitive effects on urban ecosystems.

Evan Grant, a technician with the BES, collects water samples in Baltimore's Carroll Park. The water is analyzed for pollution, bacteria, and nutrients.

Steward T.A. Pickett

Applying Lessons Learned

"One can think of plant and animal communities that have coexisted in nature for tens of thousands to millions of years, but in urban areas we're bringing species together that have never coexisted before," says Richard Pouyat of the U.S. Department of Agriculture's Forest Service. These communities of organisms are known as "emerging ecosystems," and they are as young as modern cities.

Considering how little of our time on Earth has been spent in a state of urbanized civilization, and what a tiny fraction of the history of life on Earth that represents, it is a marvel of the adaptability of ecosystems that so much life has already taken root in cities. Countless writers of science fiction have tried to imagine what might happen next—mutant cockroaches overrunning cities, the adaptive radiation of pigeons into dozens of new species specialized by varieties of trash—and here urban ecology, itself in its infancy, offers only a few clues.

It does tell us that in the future, the urban canopy will be subtly different. Gone will be the mighty oak and the stately maple; saplings of these species are already absent from the understory in urban areas. In their place, more adaptable, disturbance-tolerant breeds such as cherry will shade the streets and parks of centuries hence.

Not all the changes humans make to the urban ecosystem have to be negative. By using the knowledge that the members of the Baltimore and Phoenix studies are gathering, urban planners, architects, local politicians, and ordinary citizens will have more power than ever to predict the consequences of their actions on their immediate environment. Perhaps, if they can be convinced that it really is an ecosystem, and not just a heap of buildings and roads imposed on uncooperative nature, they will understand the importance of applying that knowledge. Z

—Christopher Mims is a freelance science writer based in Brooklyn, New York.

The Zoo is helping to conserve many African species, including scimitar-horned oryx, western lowland gorillas, and kori bustards.

Scimitar-horned oryx and kori bustard: Jessie Cohen/NZP. Western lowland gorilla: Ann Batdorf/NZP.

THE ZOO'S AFRICAN ODYSSEY

BY SHANNON LYONS

In travel brochures, Africa looks like a wildlife watcher's paradise. Scenes of lions lazing in the sun, cheetahs on the hunt, and herds of elephants and zebras suggest a continent teeming with animals.

Such a rich abundance of wildlife was once a reality throughout Africa, but now protected areas and patches of inaccessible wilderness provide some of the last refuges for these and many other species. Their habitats are shrinking as Africa's cities, villages, and demands for its natural resources grow. And their populations are declining due to illegal hunting, pollution, and climate change.

The Smithsonian's National Zoo understands that the future of Africa's wildlife depends on science and conservation efforts. Zoo scientists and educators are leading studies in Africa and pioneering research on African species at the Zoo and at its Conservation and Research Center in Front Royal, Virginia. Their collaborations range from training and outreach programs to conserve biodiversity regionally to large-scale studies supported by global corporate partners.

This year's ZooFari theme, "Savanna Soirée," and this issue of *ZooGoer* celebrate the Zoo's dedication to conserving African wildlife and habitats.

Visit this story online at **www.fonz.org/africanspecies.htm** for links to more information on the Zoo's work with African species.

DESERT

The Sahara and the Sahel | *Northern Africa*

John Newby/SCF

An acacia tree grows in the arid Sahara, which transitions to the scrubby grasslands of the Sahel.

The Sahara is so iconic that in the simplest geographical terms, it defines Africa. It dominates a hot and mostly arid region in northern Africa that has roughly the same land area as Australia. This region is called Saharan Africa, and everything south of it—nearly two-thirds of the continent containing incredibly diverse topography, ecosystems, wildlife, and people—is simply called sub-Saharan Africa.

The Sahara is more nuanced than the stereotypical desert. Sand dunes, or *ergs*, cover only 20 percent of it. Its most prevalent feature by far is gravelly plains called *regs*. There are also depressions filled with salt called *chotts*, oases with trees, and mountains and plateaus that may be as tall as 1,000 feet. But despite this diversity of topographical features, water and vegetation are scarce, and wildlife in the Sahara have adapted to a hardscrabble existence.

The desert gradually softens at its southern border into a narrow belt of semi-arid grassland called the Sahel. Spanning the width of the continent from the Atlantic to the Red Sea, the Sahel marks the transition from Saharan to sub-Saharan Africa. The rainy season arrives in the Sahel between July and September, reviving drought-resistant trees and grasses, giving relief to hungry wildlife, and swelling the Niger River so that farmers can cultivate crops in its delta.

Although the Sahara-Sahelo region is naturally harsh, human activities pose a far greater risk to wildlife than extreme temperatures or lack of water. National Zoo scientists are working to save these animals from extinction.

SCIMITAR-HORNED ORYX

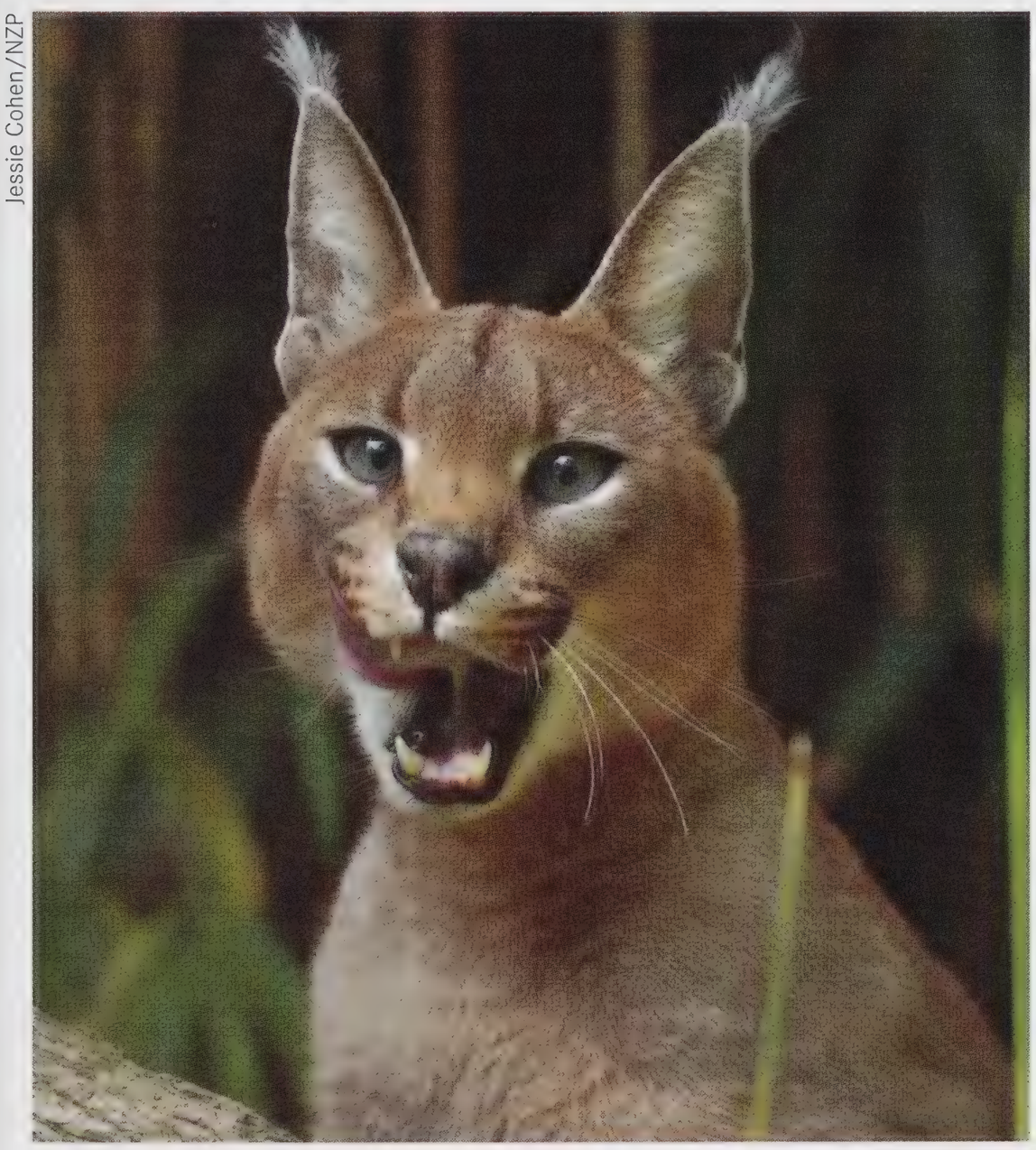
The Sahara and Sahel once supported herds of scimitar-horned oryx (*Oryx dammah*), dama gazelle (*Gazella dama*), and other desert antelope. But the scimitar-horned oryx is now extinct in the wild, and the dama gazelle's overall population is fewer than 1,000. Illegal hunting, droughts exacerbated by climate change and desertification, and lack of protected areas have plagued desert antelope, which must now also compete with grazing livestock for food. As they fade away, carnivores and scavengers that depend on them will likely suffer population declines, too.

In the last 15 years, Zoo scientists pioneered artificial insemination for scimitar-horned oryx, and developed husbandry and genetic management techniques that helped increase the world's managed zoo population to 2,000. Two of these oryx are on exhibit at the Zoo's Cheetah Conservation Station and several dozen have been reintroduced into fenced areas in Morocco.

As part of their conservation strategy, Zoo scientists hope to create a 30,900-square-mile protected area in Niger for antelope and other Sahara-Sahelo species. They also want to increase research and education efforts to save these rare animals.

Jessie Cohen/NZP

Jessie Cohen/NZP



CARACAL

Caracal courtship may involve elaborate overtures of head rubbing, scent marking, and meows. It's even more complicated for the National Zoo's male and female caracals (*Caracal caracal*), which will gradually get to know one another in front of a live audience. For five hours a day, seven days a week, FONZ behavior watchers will record the cats' encounters. The data they collect will help Zoo staff better understand the species and improve future introductions.

Like many animals at the Zoo, these small cats with tufts of hair sprouting from the tips of their ears were specially selected by the Association of Zoos and Aquariums' (AZA) Population Management Plan to breed and, through their offspring, maintain genetic diversity in zoo populations. It's an important goal for caracals, because they are fairly rare in northern Africa and threatened in their Asian habitats. Although much more abundant in southern Africa, they have an exaggerated reputation as livestock killers there and are often treated as vermin. Conserving them in zoos is one way to keep them from becoming extinct in the future.

FOREST

Gabon | *Central Africa*

Carlton Ward, Jr.

National Zoo scientists document and help protect biodiversity in southwestern Gabon's wetlands, forests, beaches, and grasslands.

There's no mistaking the green hills, wetlands, and sand beaches of Gabon for the scorched Sahara. Forests cover 77 percent of this country on Africa's Atlantic coast, providing habitat for African forest elephants, western lowland gorillas, chimpanzees, and hundreds of other species of conservation concern.

Yet until recently, little was known about Gabon's biodiversity. What plants and animals live there, and how do they interact with their environment? And how do humans and their roads, farms, houses, and oil operations affect ecosystems? The answers could be powerful tools for conservation.

Since 2000, Zoo scientists from the Smithsonian's Monitoring and Assessment of Biodiversity (MAB) program have been leading a team of international scientists seeking those answers in the 4,270-square-mile Gamba Complex of Protected Areas in southwestern Gabon. For the first time ever, they are documenting Gabon's rich variety of living things and habitats, with the encouragement of the Gabonese government and local communities. So far, they have cataloged nearly 3,000 species and have discovered fish, amphibians, reptiles, insects, orchids, and trees that are new to science.

The program's ultimate goal is the long-term conservation of Gabon's biodiversity. To that end, MAB partners with Shell Gabon, Shell Foundation, and national organizations to integrate biodiversity conservation into oil and gas development, provide education and outreach programs, and provide technical training for Gabonese researchers and conservationists.

Carlton Ward, Jr.

AFRICAN FOREST ELEPHANT

African forest elephants (*Loxodonta cyclotis*) are smaller and more elusive than African savanna elephants, but they have a mighty power—they help shape the equatorial forests in which they live. They disperse the seeds of fruit trees, an important food source for many species, over large distances.

Zoo scientists are conducting a three-part study of these little-known leviathans in Gabon. The study centers on an industrial corridor that divides two national parks in the Gamba Complex. Although this corridor has a high level of biodiversity and is likely an important route for migrating animals moving between the parks, its official status as a protected area remains unclear.

In one part of the study, scientists conduct systematic dung count surveys to see whether the elephants prefer different habitats depending on the season. In another part, they analyze DNA from fecal samples to estimate the number of males and females in the area and to determine whether the corridor's elephants are transient or resident. And in a third part of the study, scientists from the Zoo and the Wildlife Conservation Society are using a global positioning system to track the movements of four forest elephants they radiocollared in the corridor.

The study's results will guide the management and conservation of the corridor, an important step for conserving forest elephants in one of the few remaining areas where their populations are still viable. Forest elephants are threatened by hunting, logging, human encroachment on their habitat, and roads, according to a 2006 study coauthored by MAB scientists.

WESTERN LOWLAND GORILLA

The total population of endangered western lowland gorillas (*Gorilla gorilla gorilla*) is unknown, but scientists estimate that fewer than 100,000 remain in Gabon and in the fragmented forests of other equatorial African countries. Like African forest elephants, western lowland gorillas are targeted by commercial and subsistence hunters and are rapidly losing their habitat. Hundreds of them may already have succumbed to the Ebola virus.

The Zoo's group of six western lowland gorillas gives staff and visitors an incredible glimpse into these rare apes' highly social lives. Four of its members, including the dominant silverback Baraka, were born at the Zoo under the auspices of the AZA's Species Survival Plan (SSP) for the species.

Jessie Cohen/NZP

SAVANNA

Southern and Eastern Africa

This region boasts some of Africa's most varied, and famous, landmarks. From Mount Kilimanjaro and Lake Victoria in the east to the Kalahari and its Okavango Delta in the south, the beauty of the land is world-renowned. But it is the area's grasslands, or savannas, that support Africa's most famous wildlife.

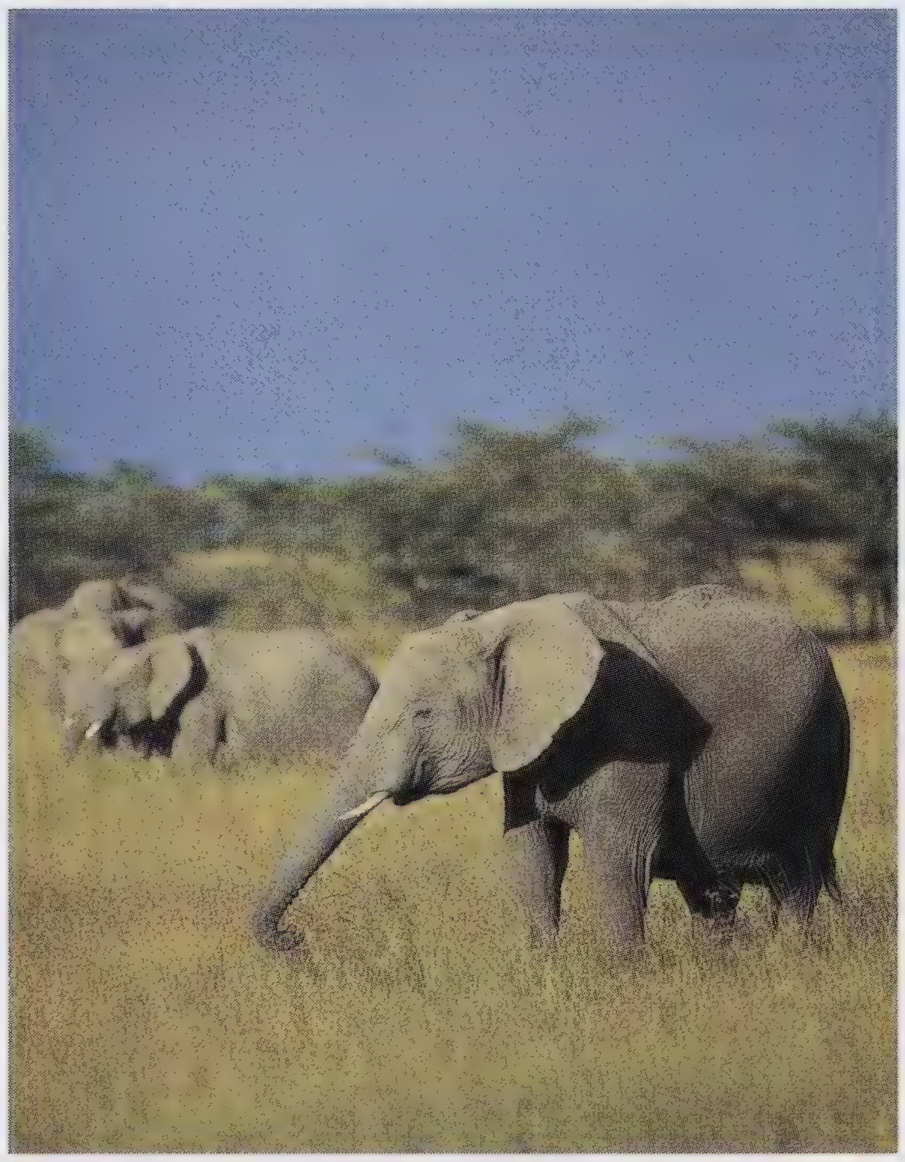
The Serengeti Plains of Kenya and Tanzania, for example, are the only place on Earth where millions of wildebeest and hundreds of thousands of zebras migrate each year, and where another sort of animal first appeared about two million years ago—*Homo habilis*, a species of early human. Most of Africa's cheetahs, lions, and elephants also live on savannas.

Although the region's national parks and other protected lands go a long way toward conserving African wildlife, they are no panacea. Animals know nothing of park boundaries, and when they wander outside to migrate or find food, they are often killed by poachers, people protecting their livestock and crops, or subsistence hunters. According to Serengeti National Park's official website, "in an average year, local people living around the park illegally kill about 40,000 animals." And disease, habitat destruction, and droughts threaten wildlife regardless of whether they live in a park.

Working in a wide range of disciplines including reproduction science, genetics, and behavior studies, Zoo scientists are helping to conserve Africa's savanna wildlife.

African savannas support migratory animals such as this herd of savanna elephants, which is browsing on the Serengeti Plains in Tanzania.

Anup Shah/naturepl.com



SAVANNA ELEPHANT

The world's largest land animal, the African savanna elephant (*Loxodonta africana*), originally lived through much of Africa. But in the last 150 years it was extirpated from the Sahara and now survives mostly in southern and eastern Africa.

Savanna elephants compete with people for limited habitat and resources. When hungry or thirsty, they can devastate farmers' crops and water supplies, and when agitated, they can kill people and livestock. People shoot elephants or fence them out of large areas to protect their own lives and livelihoods.

With wild savanna elephants in danger, zoo elephants may be crucial for the long-term survival of the species. But the aging U.S. zoo population is not reproducing enough to sustain itself. To find out why, Zoo scientists study savanna elephant reproduction in Kruger National Park in South Africa and in U.S. zoos. They are using their data and are pioneering artificial insemination techniques to improve zoo elephant breeding programs.

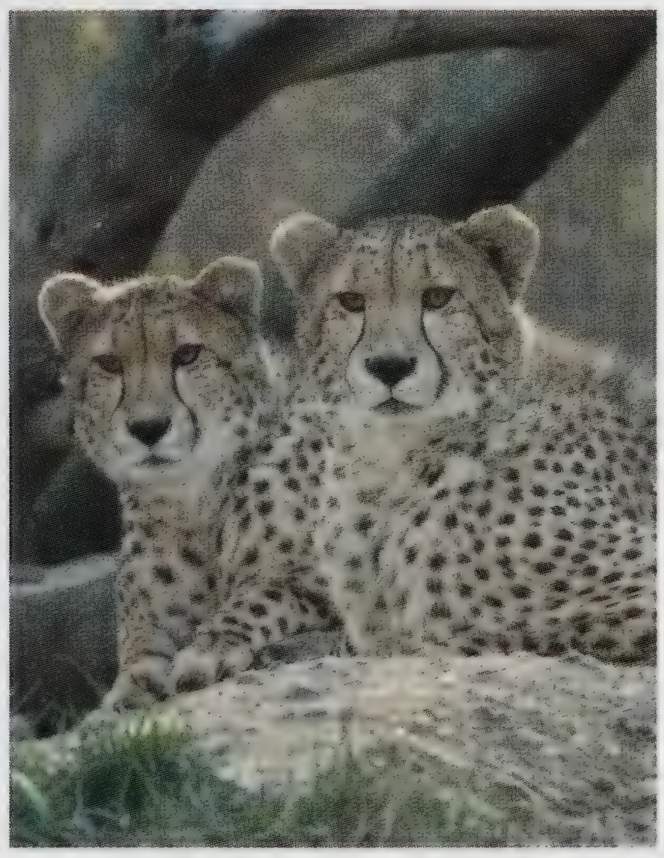
The Zoo also supports a genetic study of the savanna elephants living in Amboseli National Park, Kenya. This study will increase our understanding of savanna elephants' kinship and social relationships.

AFRICAN WILD DOG

Despite the beautiful patches of color on their coats, African wild dogs (*Lycaon pictus*) don't attract much conservation attention. But they desperately need it. Fewer than 5,000 live in isolated populations in eastern and southern Africa, although they once lived throughout sub-Saharan Africa. Long persecuted as livestock killers, the dogs also suffer from habitat fragmentation, competition with other carnivores, collisions with cars, and diseases such as distemper and parvo virus.

Only one viable population of wild dogs exists in South Africa. Zoo scientists are collaborating with South African researchers and wildlife managers to establish a second population in Hluhluwe-iMfolozi Park. Their efforts include studies of wild dogs' stress hormones, behavior, and ecology, as well as wild dog reintroductions.

Ingo Arndt/naturepl.com



Jessie Cohen/NZP

CHEETAH

Historically, breeding cheetahs (*Acinonyx jubatus*) in zoos has been difficult. So Zoo curators, keepers, and scientists put their heads together to find out why. Their extensive behavioral and reproduction studies led to better management practices and contributed to a major milestone: The Zoo's first litter of cheetah cubs was born at its Cheetah Conservation Station in 2004, followed by a second litter in 2005.

These births are just one facet of the Zoo's 25-year involvement in cheetah research, which continues to grow. At the Zoo and at the Namibian headquarters of the Cheetah Conservation Fund, Zoo scientists are developing assisted reproduction techniques such as artificial insemination and sperm cryopreservation that have yielded litters at other zoos. And in 2007, the Zoo achieved another milestone when it announced it will build a state-of-the-art breeding and research facility for cheetahs at its Conservation and Research Center in Front Royal, Virginia.

Mehgan Murphy/NZP

MEERKAT

Meerkats (*Suricata suricatta*) live in groups of up to 40 individuals in southern African savannas and deserts—and at the Zoo's Small Mammal House. Zoo scientists have participated in studies of meerkats' fascinating social behavior since 1993.

Marguerite Smits Van Oyen/naturepl.com

AFRICAN LION

Like elephants and wild dogs, African lions (*Panthera leo*) inhabit a fraction of their former distribution, and for many of the same reasons: habitat fragmentation, hunting, and disease. Zoos may provide a safeguard against lions' extinction.

To help maintain a healthy zoo population of these regal animals, some North American zoos are importing captive-bred southern African lions under the auspices of the AZA's SSP for lions. The National Zoo obtained three of these lions from South Africa in October 2006: one-year-old male Luke and two-year-old females Shera and Nababiep. They may one day parent a new generation of lion cubs.

Zoo scientists also advise the lion SSP and coordinate a research project on lions in North American zoos. By analyzing hormones in fecal samples from more than 30 lions in North America, Zoo scientists hope to better understand the reproductive biology of this charismatic species, identify the causes of poor reproduction, and improve breeding success in zoos.

Tony Heald/naturepl.com

GREVY'S ZEBRA

Experts estimate that the population of endangered Grevy's zebras (*Equus grevyi*) living in Kenya and Tanzania is now roughly 3,000. That's a drastic drop from the 1970s, when the zebras had a much larger distribution and an estimated population of about 15,000. Increased livestock grazing, limited access to water sources, and hunting could wipe out the species entirely.

To assist the SSP's breeding program for Grevy's zebras, the Zoo has for the last 15 years housed juvenile males at its Cheetah Conservation Station until they are old enough to breed with females at other zoos. Recently, Zoo scientists also began using assisted breeding techniques such as cryopreservation of sperm to save these beautiful equids.

KORI BUSTARD

Kori bustards (*Ardeotis kori*) can fly but prefer to run from danger instead. Unfortunately, they can't run from the agricultural development, overgrazing, and poaching that have extirpated them from some parts of southern and eastern Africa.

The National Zoo is one of a few zoos in the world to successfully breed kori bustards. More than 35 chicks have hatched at the Zoo in the last decade thanks to careful management by Zoo staff, including a Bird House biologist who coordinates the kori bustard SSP and keeps the international studbook that helps zoos maintain genetic diversity in the species.

Zoo scientists are also on the forefront of kori bustard research and in the last six years they have conducted field work in Kenya and reproductive studies with zoo birds, and have published ten studies of kori bustard behavior and management. They are aided in their work by volunteer FONZ behavior watchers, who since 1999 have come to the Zoo to collect data on the bustards' activities.

Tony Heald/naturepl.com

Pete Oxford / naturepl.com

The Matschie's tree kangaroo is one of ten known tree kangaroo species that live exclusively in New Guinea.

HIGH ON KANGA ROOS

BY JOHN TIDWELL

At first glance they look like roly-poly teddy bears—but with long tails and strange, fleshy noses. They can climb trees and drop more than 65 feet to the ground without being hurt. It's said that when you meet one species, *Dendrolagus mbaiso*, in the forest it waves its arms and whistles at you. These may sound like creatures plucked from fantasy, but in fact they are real...kangaroos.

Tree kangaroos, that is.

Although they were discovered by scientists more than 180 years ago, surprisingly little remains known about them today—primarily because most live in the remote, inaccessible highland cloud forests of New Guinea. For millennia tree kangaroos flourished in the island's interior labyrinth of mountains. But now these extraordinary animals are on the verge of extinction because of the very predators who can also save them: humans.

Matt West

This golden-mantled tree kangaroo, named Nunsi, is the first living member of its species studied by scientists.

Return to the Trees

Until recently, many of New Guinea's mammals were little-known. Most of what we know about tree kangaroos has been gleaned since the 1970s, and as each new species is discovered, a fascinating portrait of these animals has been slowly emerging.

Scientists think all kangaroos and their smaller cousins, wallabies, first evolved about 55 million years ago from tree-dwelling Australian marsupials that looked like possums. In time, some of these marsupials apparently found life was safer (and the food better) back up in the trees. Over millions of years they reversed the typical land-kangaroo physique, evolving shorter hind feet and longer, stronger arms, eventually becoming the marsupial equivalent of monkeys: tree kangaroos.

Australia collided with Asia about 15 million years ago, pushing up a northern mountain range that later became New Guinea. When rising seas flooded its lowlands, New Guinea became an island, permanently isolated from Australia. The wide range of habitats on its craggy landscape gave rise to an array of plants and animals, including tree kangaroos, whose evolutionary path continues to amaze scientists. "The very concept of such an animal seems ludicrous," wrote biological anthropologist Colin Groves of Australia's National University in a scientific paper in 1982. "That such a fundamentally terrestrial animal as a kangaroo should not only take to the trees, but undergo there a successful radiation into several species, seems against all common sense."

Of the 12 known species of tree kangaroo, ten are found exclusively in New Guinea, and the other two live only in northern Australia. They form two distinctive lineages: the lowland "long-footed" group, with generally smaller heads, larger size, and broad, kangaroo-like feet that indicate they may be the most archaic species; and the highly arboreal, "short-footed" line of New Guinea's highlands. Some have even lost the ability to hop.

Most of New Guinea's tree kangaroos live high in its chilly, mountain cloud forests, where vegetation is abundant and predators rare. They are the island's largest mammal—some species weigh up to 45 pounds—and apart from a few mainly terrestrial species, they spend time high in the trees resting and browsing on tender leaves, fruits, flowers, and the occasional bird's egg. To avoid predators like the New Guinea harpy eagle (*Harpyopsis novaeguineae*), most tree kangaroos can drop straight from the treetops to the ground without serious injury thanks to their thick, strong bones.

Until the 19th century, New Guinea's tree kangaroos were known only to local clans, whose Melanesian ancestors arrived about 45,000 years ago. Highland tribal folklore often tells of furry shape-shifters of the forest that played tricks on the disrespectful.

Protein in New Guinea was often scarce, and for most clans tree kangaroos were a staple food. In 1840 zoologist Salomon Müller, who had collected tree kangaroo specimens on western New Guinea's coast, named their genus *Dendrolagus*, which is Greek for *tree hares*—not because of their appearance, but because they tasted like succulent hare.

In those days, going to New Guinea entailed a lengthy and often dangerous journey, so some Victorian naturalists "discovered" new tree kangaroo species from skins bought in Europe's fur or feather markets. In the early 20th century, the flamboyantly eccentric English aristocrat Lord Walter Rothschild hired traders to bring him specimens of several tree kangaroo species, including a reddish variety from northeastern New Guinea that he and a colleague named *D. matschiei* in 1907.

Because so few zoologists actually went to New Guinea, most of what they knew about tree kangaroos until recently was the color of the kangaroos' fur and the shape of their bones. When Tim Flannery, then an Australian graduate student, began compiling the first field guide to New Guinea mammals in the 1980s, he was shocked to discover how little real data were available. So, he resolved to find out for himself, and ventured into the remote wilderness of that mysterious island.

Flannery's Discoveries

Feverish with scrub typhus in 1985, Flannery was being carried to a mission hospital on the north coast of New Guinea when he noticed something unusual. In his 1996 memoir *Throwim Way Leg*, Flannery wrote that through his delirium, he became "intrigued

by a black claw which one of my bearers was wearing on a string around his neck. When we arrived at the mission I somehow managed to buy the necklace from him." That claw turned out to be a clue to a previously undescribed species of tree kangaroo, known to the Olo people of the Torricelli Mountains as *Tenkile*.

Three years later Flannery, now a scientist for the Australian Museum in Sydney, returned to northern New Guinea, following Olo hunters deep into the Torricellis, looking for rumored species like *Tenkile*. After weeks of searching, his efforts were rewarded when hunters returned to camp carrying a strange, black tree kangaroo. As Flannery examined the animal he later dubbed *D. scottae*, the hunters told him that when they caught an adult male, everyone in the village knew immediately because of the *Tenkile's* pungent, lingering odor, which is unlike any other tree kangaroos'.

For more than a decade Flannery explored the highland forests of New Guinea, discovering some 30 new mammals. He described four new tree kangaroo species, providing some of the first insights into their biology and inspiring a new generation of scientists to seek out and protect New Guinea's mammal species from extinction.

The discovery Flannery considers his greatest occurred in 1994 on the glacier-bound Jaya Peak in far western New Guinea. Unlike independent Papua New Guinea, which covers the island's eastern half, Indonesian-ruled West Papua was at the time less explored by scientists. Camping about 10,000 feet up in one of Jaya Peak's chilly rainforests, Flannery was told stories by local Moni tribesmen about *Dingiso*, the little furry "men of the forest" that when confronted would sit up, whistle, and raise their paws in greeting. To Flannery this sounded like a typical kangaroo threat-display, but the Moni believed these creatures were ancestor spirits who recognized them, and they never hunted them.

This bit of unwitting conservation may have saved some of the last populations of this species, because while *Dingiso* were common in Moni lands, they were completely hunted out in the neighboring Dani people's territory. In fact, overhunting may be the greatest threat to all tree kangaroos in New Guinea, as villagers venture into more-remote mountain forests to feed their growing populations.

This problem was on Flannery's mind when a Dani hunter brought him that first beautiful, black-and-white specimen of *Dingiso*. Flannery gave the species the name *mbaiso*, the Moni word for "forbidden animal," hoping to deter other clans from wiping it out.

The Dani said *Dingiso* was rarely seen in trees, and Flannery suspected it was largely terrestrial, yet another twist in the up-and-down evolution of these amazing marsupials. *Dingiso* also seemed unafraid of humans. "When the hunters find it, they offer it some choice leaves and it approaches them," Flannery wrote in *Throwim Way Leg*. "Then they simply slip a noose around its head and lead it away." If a large mammal like *Dingiso* could remain totally unknown to science for so long, Flannery noted, who knows what other new species might still lurk in New Guinea's remote forests?

Matschie's Tree Kangaroo

Lisa Dabek's first encounters with live tree kangaroos weren't in the depths of a tropical forest, but at zoos here in the U.S. In 1987, she was a graduate student specializing in marine mammals, but after studying the mothering behavior of *D. matschiei* with Judie Steenberg, a keeper at Seattle's Woodland Park Zoo, Dabek became so enthralled that she made tree kangaroos the focus of her career.

Five years later, she did pioneering research on *matschiei* reproductive biology at the Smithsonian National Zoo's Conservation and Research Center in Front Royal, Virginia, helping curator Larry Collins design the first breeding program for what was then the largest collection of tree kangaroos in North America. It was a life-changing experience. "Our research became the bedrock of my entire career," Dabek explains. "It made everything I've done since then possible, and probably saved Matschie's tree kangaroo from extinction." Further inspiration came when she met Flannery at an Australian tree kangaroo conference in 1994. His intrepid example prompted Dabek to defy prevailing notions that studying these elusive animals would be too expensive and hazardous.

TKCP

Lisa Dabek's research team on the Huon Peninsula.

In 1996, she founded the first-ever Tree Kangaroo Conservation Program (TKCP) with support from 16 North American zoos, and launched the first field studies of *D. matschiei*, deep in the scientific *terra incognita* of Papua New Guinea's northeastern Huon Peninsula. For nearly five weeks, she and a graduate student explored the central forests of this hulking, 650-mile ridge of jagged limestone, the only place where *matschiei* has been found. But all she discovered were clawed tree trunks and thousands of little green tree-kangaroo droppings.

Then one day, while following some local Yupno hunters through the dense, mossy forests around the Huon's Finnisterre Mountains, Dabek's luck changed. When the hunters' dogs began barking at something high in a tree, she peered up and saw the creature the Yupno called *Klapgaman*: a stout, red animal with a soft pink nose and furry ears. "It looked like a big stuffed animal," Dabek recalls. "I watched that tree kangaroo for nearly an hour, and then didn't see another one for seven years. But they were worth the wait."

Now, as Director of Conservation for the Woodland Park Zoo, Dabek oversees the support of more than 30 different international endangered species projects and leads one of New Guinea's most successful conservation efforts. Like other tree kangaroos, once-abundant *D. matschiei* are so overhunted that they are found only in high alpine forests, the territory of the Yupno and other clans for millennia. Because of this, Dabek realized the only way to create a no-hunting zone where the species could be protected and studied was to make local clans firm partners of her project. The TKCP is negotiating an agreement with 26 clans to set aside about 312 square miles of tree kangaroo forest, creating a vast conservation area where landowners are the wildlife stewards, and poaching is punishable by law. Once approved by Papua New Guinea's government, these lands will become the island's first official conservation area.

Every year Dabek and her team hike nine hours into the rain-soaked highlands of Wasaunon, her primary field site in the protected area, and home to a flourishing array of rare, native wildlife. The scientists, led by graduate student Gabriel Porolak, often spend months 10,000 feet above sea level in these lush, mossy forests, gathering pioneering data on a local population of *matschiei*. They found that like most tree kangaroos, *matschiei* are predominantly vegetarians, getting their deep rusty color from acidic tannins in their diet. While *matschiei* are largely solitary animals, far-ranging males keep close track of the females in their area, which are receptive to mating for just two days every two months.

So far, Porolak has fitted 13 Wasaunon 'roos with radiocollars, using global positioning system satellite data to figure out their natural range—vital for designing a conservation area. It's lots of long hours and tough, soggy conditions, but Dabek is in her element. "This is really intense work," she says. "It really challenges you on so many different levels: You're hacking through the brush. You're radiotracking—and radiotracking a strong male is a real challenge—and it's all new to science!"

Matschie's tree kangaroo.

Norman Owen Tomalin/Bruce Coleman Inc.

The Most Beautiful Kangaroo

The Olo people of the Torricelli Mountains had a legend of a forest creature called the *Weiman* or *Weimanke*, an animal with a very pale face. Exploring the Foja Mountains of western Papua in the 1980s, Pulitzer prize-winning author and scientist Jared Diamond reported glimpsing a striking, white-faced tree kangaroo, but couldn't snap a photo before it vanished. Nearly a decade later and hundreds of miles to the east, Tim Flannery was exploring Mount Sapau in the Torricellis when one of his colleagues returned to camp carrying two spectacularly colored *Weiman*: Their ears were rimmed in white, their shoulder fur was lustrous gold, their backs were deep burgundy, and white rings swirled down their long tails. Flannery named the species *D. goodfellowi pulcherrimus*—"most beautiful" in Latin—and described them as a subspecies of Goodfellow's tree kangaroo. But no one could prove this family link, because he only found two animals.

Then, in December 2005, an international team of scientists was allowed to explore the Foja Mountains, its helicopter landing in a realm of animals thought to be exceedingly rare or even extinct. Lush, wet, and cold, it was prime tree kangaroo territory, and early one morning Kristofer Helgen, the team's mammalogist and a scientist at the Smithsonian's National Museum of Natural History, awoke to his trackers excitedly showing him a large *Weiman* they'd caught—the first one found by scientists outside the Torricellis, and proof *Weiman* weren't as endangered as they had feared. The *Weiman* is now classified as *D. pulcherrimus* and its common name is the golden-mantled tree kangaroo.

About the same time, Australian zoologist Jim Thomas was visiting the scattered villages of Sandaun Province, in the Torricelli Mountains. He and his wife Jean had run the Tenkile Conservation Alliance for two years, hoping to do for the *Tenkile* what Lisa Dabek had achieved for *D. matschiei*. Working on a shoestring budget from a tin-roofed bush house, the Thomases successfully negotiated a two-year hunting moratorium among 12 villages in *Tenkile* territory, encouraging locals to raise domestic rabbits for meat instead of hunting 'roos.

When he arrived in the Nunsi community village in December 2005, hunters presented Thomas with a squirming baby male *D. pulcherrimus*—the first living one any scientist had ever studied. Now about two, "Nunsi" is a cuddly ambassador for his species, helping the Thomases broker a *Weiman* hunting ban in March 2006 in eastern Sandaun where the species is thought to live. Advised by the TKCP, Thomas wants to begin radiocollaring both species, to fill in some of the scientific blanks about these elusive animals. But raising the necessary funds could take years.

It's an important fact about New Guinea's tree kangaroos: They don't give their secrets away easily. Those who want to learn must stay for the long haul, which apparently suits Jim and Jean Thomas just fine. "You could say this is a dream come true," Jim says, "but basically I just didn't give up—and when you are committed to real conservation, you can't." Z

—John Tidwell is a freelance journalist who lives in Silver Spring, Maryland.

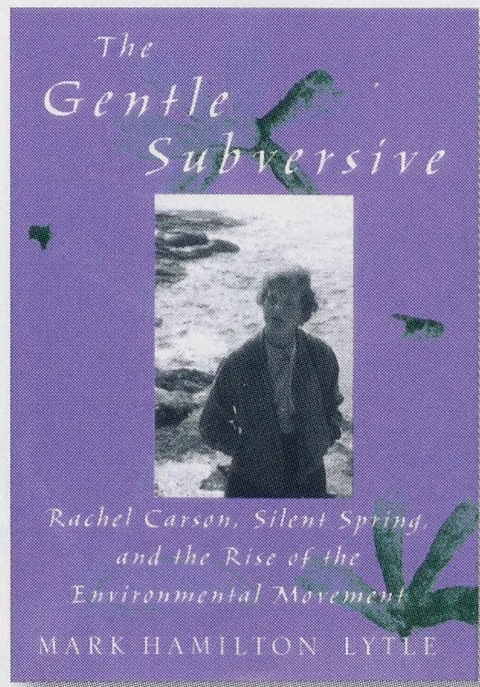
A Life for Nature

The Gentle Subversive: Rachel Carson, Silent Spring, and the Rise of the Environmental Movement
Mark Hamilton Lytle. 2007. Oxford University Press, New York. 277 pp., hardbound. $23.

Exactly 45 years after the publication of her environmental manifesto *Silent Spring*, this year Rachel Carson would have celebrated her 100th birthday. So it is a timely moment for the publication of this slim biography of a woman credited with inspiring the modern environmental movement with what she called her "poison book." *The Gentle Subversive* tells the story of Carson's life, from her youth as an aspiring author with a love of nature, through her years as a working biologist when few woman were, to the flourishing of her career as natural history writer, and finally as a crusader for environmental health.

Most people today know the name Rachel Carson—*Time* magazine listed her among the 100 most influential people of the 20th century—and, if they remember nothing else about her, recall that she had something to do with getting DDT banned. Of course, she is best known for her book *Silent Spring*, which seems to resonate even among those who can't name its author. It has never gone out of print and is a staple of environmental science reading lists. But I was surprised to learn that she was a best-selling author a decade before *Silent Spring* graced the *New York Times'* Best Sellers List for 31 weeks. In fact, her most successful book from a commercial point of view was *The Sea Around Us*, a lyrical and scientifically accurate exploration of oceans, from their creation to their creatures to our own dependence upon them. Her next book, *The Edge of the Sea*, took readers on an intimate tour of the ecology of shore habitats, and it too was a best seller.

With these books, Carson was among the first popularizers of the then relatively new science of ecology, with its focus on the interdependence of all life. She also promoted a biocentric view of nature, "informed by a Darwinian approach to evolution, in which humans were just another species, albeit a dangerous and often destructive one." At a time when most Americans believed nature was the enemy—and with new technology promising to defeat it once and for all—Carson was far ahead of her time. With the publication of *Silent Spring*, she was also on the wrong side of the corporate, government, and scientific establishments that were developing, promoting, and profiting from that technology.



Silent Spring was a departure for Carson, who was trained as a marine biologist and, until the financial success of *The Sea Around Us*, was a writer and biologist with the U.S. Fish and Wildlife Service. Carson devoted years to mastering the science behind synthetic herbicides and pesticides that had been used indiscriminately to kill weeds and bugs since the end of World War II, she also tracked down the scientists and their research that bolstered her case against this chemical assault on nature that also threatened human health.

For all her careful explication of the science, Carson still wrote like a poet. Her title, *Silent Spring*, is both metaphor and prediction—and unforgettable. Her first chapter, "A Fable for Tomorrow," is beautifully wrought, imagining a grim future in which the "voices of spring" have been silenced. "No witchcraft, no enemy action has silenced the rebirth of new life in this stricken world. The people had done it themselves."

When it was finally published in 1962, *Silent Spring* was enormously controversial—the *Inconvenient Truth* of its time. Carson was vilified by prominent scientists, politicians and government bureaucrats, and, of course, chemical companies. "Carson's critics attacked both her message and the messenger," writes Lytle, they accused her of everything from getting the science wrong to being a Communist. But ultimately she prevailed against "the establishment," attracting her own network of supporters and, although she did not live to see it (she died of cancer in 1964), new laws and regulations to protect people and the environment from the ill effects of "better living through chemistry."

Or did she? As I was writing this review, the *Los Angeles Times* reported that a new study links the use of steroids to fatten cattle to fertility problems in the sons of women who ate a lot of beef during their pregnancy. And this is just one random example. Every day, it seems, there are reports of some deleterious effect on people or wildlife of some chemical or another.

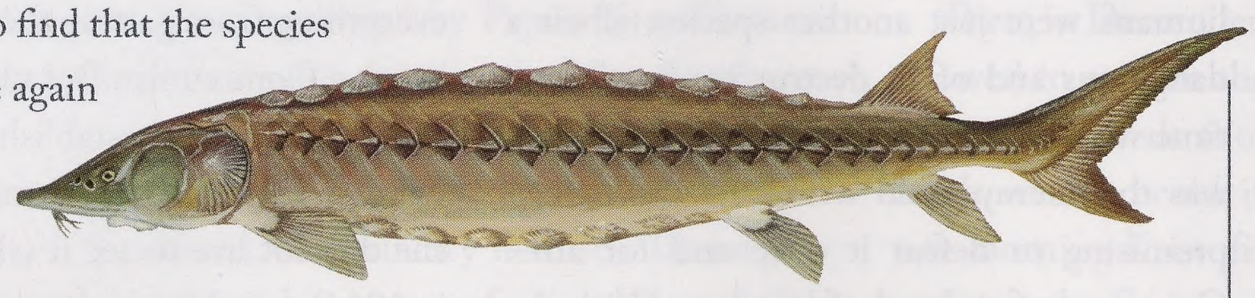
Author Mark Hamilton Lytle is a professor of history and environmental studies whose previous book, *America's Uncivil Wars: The Sixties Era from Elvis to the Fall of Richard Nixon*, explores the rise of new social movements, from environmentalism and feminism to consumer activism, during that turbulent time. So he also sets Carson and her influence in this wider historical context, noting that the modern environmental movement "...embodied her hopes for reconciliation between humans and nature." A hope that unfortunately remains unfulfilled.

—*Susan Lumpkin*

by Shannon Lyons

Fishing for a Comeback

The shortnose sturgeon (*Acipenser brevirostrum*) inhabits most major river systems on the U.S. eastern seaboard but went extinct in the Potomac—or so it was thought. Although the species has managed to survive for the last 70 million years, its Potomac population took a dive just a century ago due to pollution, dams that inhibited spawning, and fishing nets set for other species. But it may be poised for a comeback, according to a February press release from the U.S. Fish and Wildlife Service (USFWS), which has classified the shortnose as endangered since 1967. Biologists have caught and tagged two egg-laden females on spawning runs in the historic river since April 2006, a sign that sturgeons are breeding there. By tracking these fishes' movements and searching sites suitable for sturgeon spawning, the USFWS hopes to find that the species will flourish once again in the Potomac.



What's in a Name?

What distinguishes a crayfish from a lobster? Both crustaceans have ten legs, hard exoskeletons, and menacing claws, but their lifestyles are oceans apart. While lobsters never leave their saltwater homes, crayfish sometimes venture out of their freshwater habitats and onto land.

The U.S. has the highest diversity of crayfish in the world—more than 250 species—and a variety of names for them. In some states they're called "crawdads," or "mudbugs" because they resemble insects and dig their burrows in muck. And in Louisiana, where they appear in dishes such as étouffée, they've been "crawfish" since the 19th century.

The devil crayfish (*Cambarus diogenes*) is native to more than 30 U.S. states and Washington, D.C., but is named for the Greek philosopher Diogenes. Born around 400 B.C.E., Diogenes ridiculed civilized life and was rumored to have lived in the streets of Athens in an overturned tub—a singular abode not unlike the igloo-shaped mud mounds that cover *C. diogenes* burrows.

For humans, female *Anopheles* mosquitoes are the world's deadliest animals. As carriers of the parasite that causes malaria, they infect between 350 and 500 million people and kill more than one million people each year.

How Do Hummingbirds Hover?

Hummingbirds are the only vertebrates capable of sustained hovering, and they're certainly built for it. Using two powerful flight muscles in their chests, which account for a third of their total body mass, they can beat their wings more than 80 times per second. Two extra pairs of ribs add stability to their flight, and their shoulder joints can rotate nearly 180 degrees, making them agile enough to fly sideways, backward, and upside down. The mechanics of their flight also help. While all other birds' wingbeats support 100 percent of their weight on the downstroke, hummingbirds' downstroke supports only 75 percent of their weight; their upstroke supports the other 25 percent, giving them extra lift while hovering.

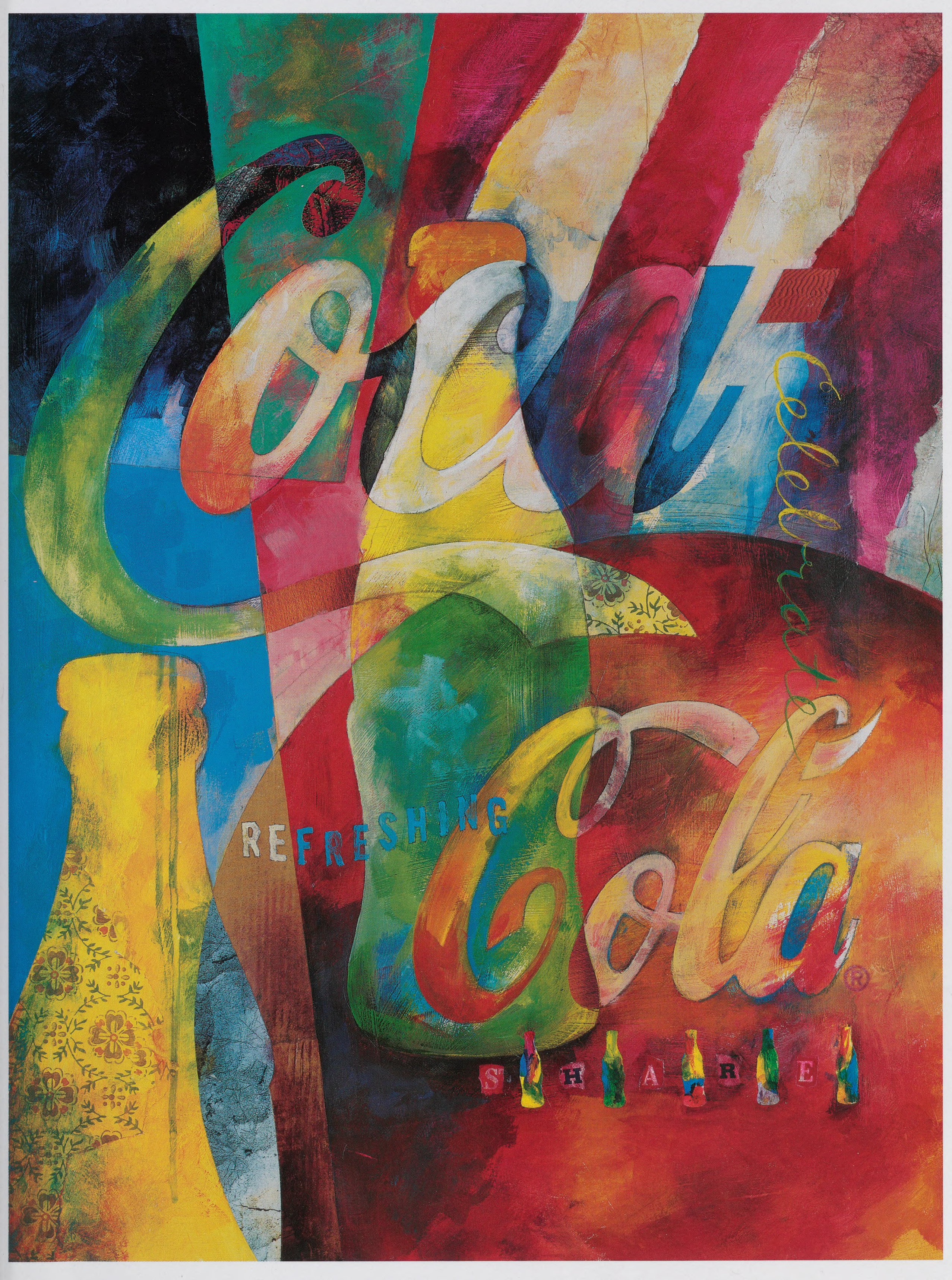
Fact or Fiction: All Cuckoos are Parasitic

Besides popping out of ornate clocks, cuckoos are known for laying their eggs in other species' nests. This behavior is called brood parasitism, and it's murder on the host parents, whose young are typically pushed out of the nest by the cuckoo chick or starved to death when it hogs all the food. In reality, only 53 of the world's 136 cuckoo species are brood parasites. The rest rear their own young, live in communal groups in which they take turns caring for offspring, or occasionally lay eggs in nests of other birds of their own species.

In Season

Look for jack-in-the-pulpit (*Arisaema triphyllum*) blooming in eastern North America's wet woodlands and swamps between April and June. This perennial belongs to the same family (Araceae) as the calla lily, and its flowers have a similar structure. A cup-shaped leaf called a spathe tapers to a triangular point that curls over a spike-like structure called a spadix. The common name likens the spadix, which sometimes has a bulbous head, to a man—or "jack"—standing in the pulpit-shaped spathe. In late summer or early autumn the spathe falls away and berries on the spadix turn bright red.

Sturgeon: Duane Raver/USFWS. Crayfish (*Orconectes immunis*): Gail Shumway/Bruce Coleman Inc. Mosquito: James Gathany & Frank Collins/University of Notre Dame/CDC. Broad-billed hummingbird (*Cynanthus latirostris*): Bob & Clara Calhoun/Bruce Coleman Inc. Jack-in-the-pulpit: William M. Ciesla/Forest Health Management International.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